

ASMJP.135AUS

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Kamal Kisho Goundar  
Appl. No. : 10/616,163  
Filed : July 9, 2003  
For : METHOD OF FORMING  
SILICON CARBIDE FILMS  
Examiner : Monica D Harrison  
Group Art Unit : 1829

DECLARATION UNDER RULE 1.132

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

I, Kiyohiro Matsushita, do hereby declare as follows:

1 I have worked as a researcher for ASM Japan which is the assignee of this application since September 1, 1999 where I have researched on development of new plasma CVD processes. I am familiar with plasma CVD technology.

2 I have read the present specification and claims, and the following experiments were conducted by me to determine effects of application of low-frequency RF energy on characteristics of SiCN films (an example of the claimed invention) and SiC (a comparative example) in terms of stress, leakage current, and dielectric value.

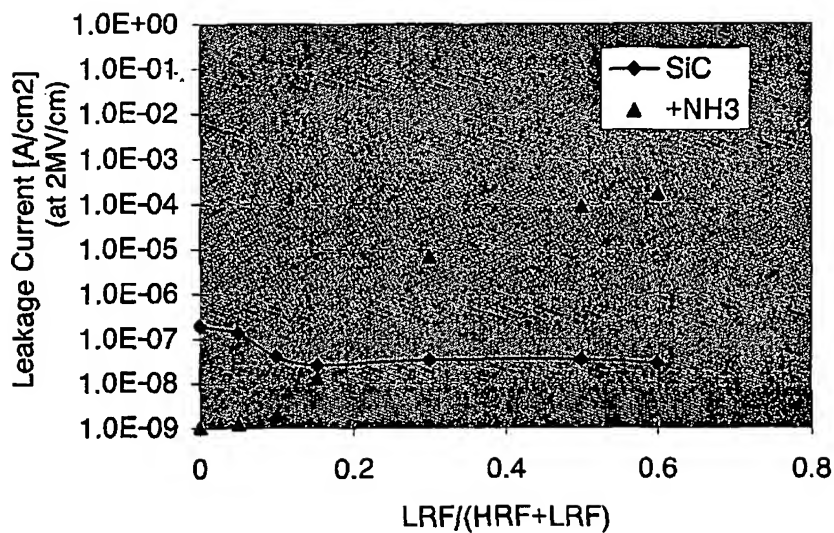
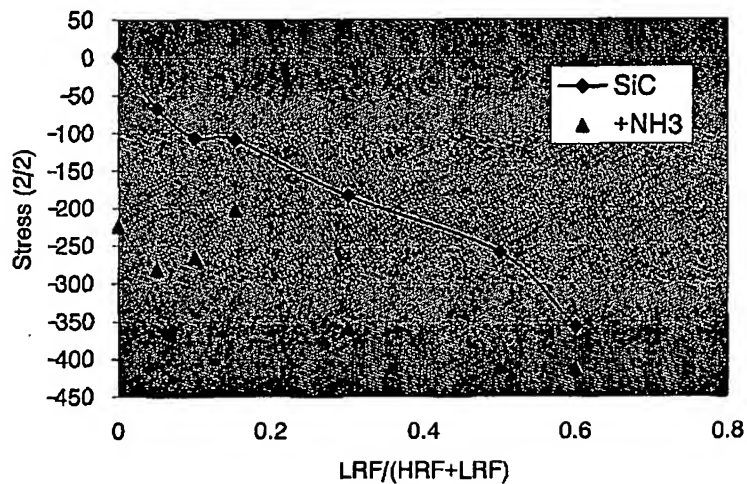
3 SiCN films and SiC films were deposited at a thickness of 200 nm on respective wafers ( $\phi$ 200 mm) using a plasma CVD apparatus, Eagle<sup>TM</sup>-10 (ASM Japan). The experimental conditions were as follows:

	SiCN	SiC
Susceptor temperature	345°C	345°C
Showerhead temperature	200°C	200°C
Wall temperature	120°C	120°C
Pressure	665 Pa	665 Pa
TMS	180 sccm	240 sccm
He	2,600 sccm	220 sccm
NH3	250 sccm	0 sccm

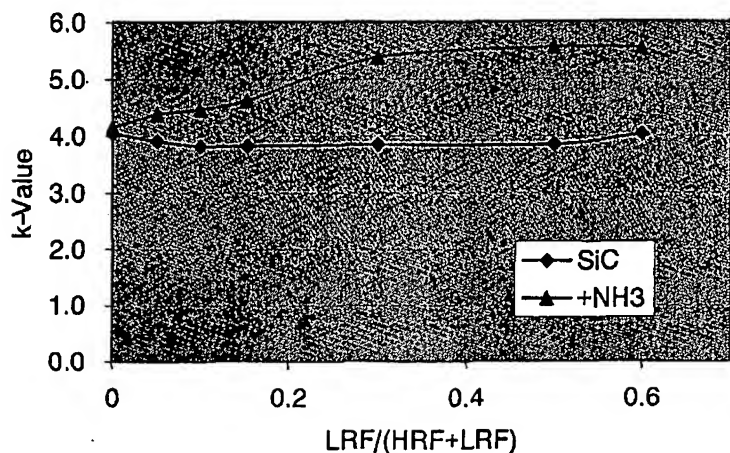
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	1	2	3	4	5	6	7
HF (27.12 MHz)	650	618	585	550	455	325	260
LF (400 kHz)	0	33	65	100	195	325	390
LF/(HF+LF)	0	0.05	0.1	0.154	0.3	0.5	0.6
Total [W]	650	650	650	650	650	650	650

4 The results are shown in the graphs below.



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5 As can be seen from the graphs, effects of LF are significantly different between SiCN and SiC. First, SiCN shows significantly low leakage current (about  $1 \times 10^{-8}$  A/cm<sup>2</sup> or less) when the LF ratio was up to about 0.15, as compared with SiC. Second, SiCN shows significantly high compressive stress (less than 200 MPa) when LF applied, as compared with SiC. Third, SiCN shows relatively high k-value but when the LF ratio was up to about 0.15, the k-value can be less than 5.0.

6 In view of the leakage current and k-value, the LF ratio is preferably about 0.15 or less, and within that range, the compressive stress is the highest when the LF ratio is 0.05.

7 I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 101 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Respectfully submitted,

Dated: February 21, 2005

By: 松下 清広  
 Kiyohiro Matsushita